

Rediscovery of Curioni's slab: the oldest scientific description of vertebrate footprints from Italy

Marchetti L.¹, Romano M.², Petti F.M.^{3,4}, Bernardi M.^{4,5}, Citton P.⁶, Rossi R.⁷, Schirolli P.⁸

¹Umweltmuseum GEOSKOP, Burg Lichtenberg (Pfalz), Thallichtenberg, Germany; ²Leibniz Institut for Research on Evolution and Biodiversity, Museum für Naturkunde, Berlin, Germany; ³Società Geologica Italiana, Rome, Italy; ⁴MUSE - Museo delle Scienze di Trento, Trento, Italy; ⁵School of Earth Sciences, University of Bristol, Bristol, UK; ⁶Dipartimento di Scienze della Terra, Università "La Sapienza" di Roma, Rome, Italy; ⁷Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), Rome, Italy; ⁸Museo Civico di Scienze Naturali, Brescia, Italy

Discovery and first description

Vertebrate ichnology in Italy fully developed rather recently, especially starting from the 70's of the last century. However, fossil footprints from Italian continental successions were known since the 19th century. The first scientific note, after a short report on the same material by Geinitz (1869), was published by Curioni (1870), who described and figured a small slab with tetrapod tracks (Fig. 1) from the lower Permian strata of Lombardy (upper Trompia Valley, Alps of Brescia, Collio Formation), found by the private collector Don Giovanni Bruni between august 1856 and september 1868 in the locality "Pulpito". Here follows the original description (p.27): "Nella fig.1 presento il disegno delle impronte fisiologiche raccolte al

Pulpito, a ponente delle sorgenti del Serimand. La lastra contiene tre impronte di piedi. Le due impronte estreme sono evidentemente pentadattili... Queste due impronte presentano la direzione del piede inferiore a dritta e di quello superiore a manca, ma tra queste due impronte, che distano dalla parte superiore della più bassa alla parte inferiore della più alta di 12 cent., avviene un'altra, quasi equidistante dalla prima, la quale sgraziatamente è incompleta, per rottura della lastra. Non presenta che quattro dita; il dito medio, nel supposto che ne manchi uno, ha una forma uncinata." "In Figure 1 I present the drawing of the physiological footprints collected at Pulpito, to the west of the Serimand sources. The slab contains

three footprints. The two extreme footprints are clearly pentadactyl... These two footprints show the direction of the lower one straight and of the upper one left, but between these two footprints, that measure 12 centimetres by the upper part of the lower one to the bottom of the higher one, there is another one, almost equidistant from the first, which disagreeably is incomplete, due to breakage of the slab. It presents only four fingers; the middle finger, in supposing that it lacks one, has a hooked shape." Subsequent publications always referred to that description, but the original specimen was never restudied, due to the absence of references about the repository in Curioni (1870).

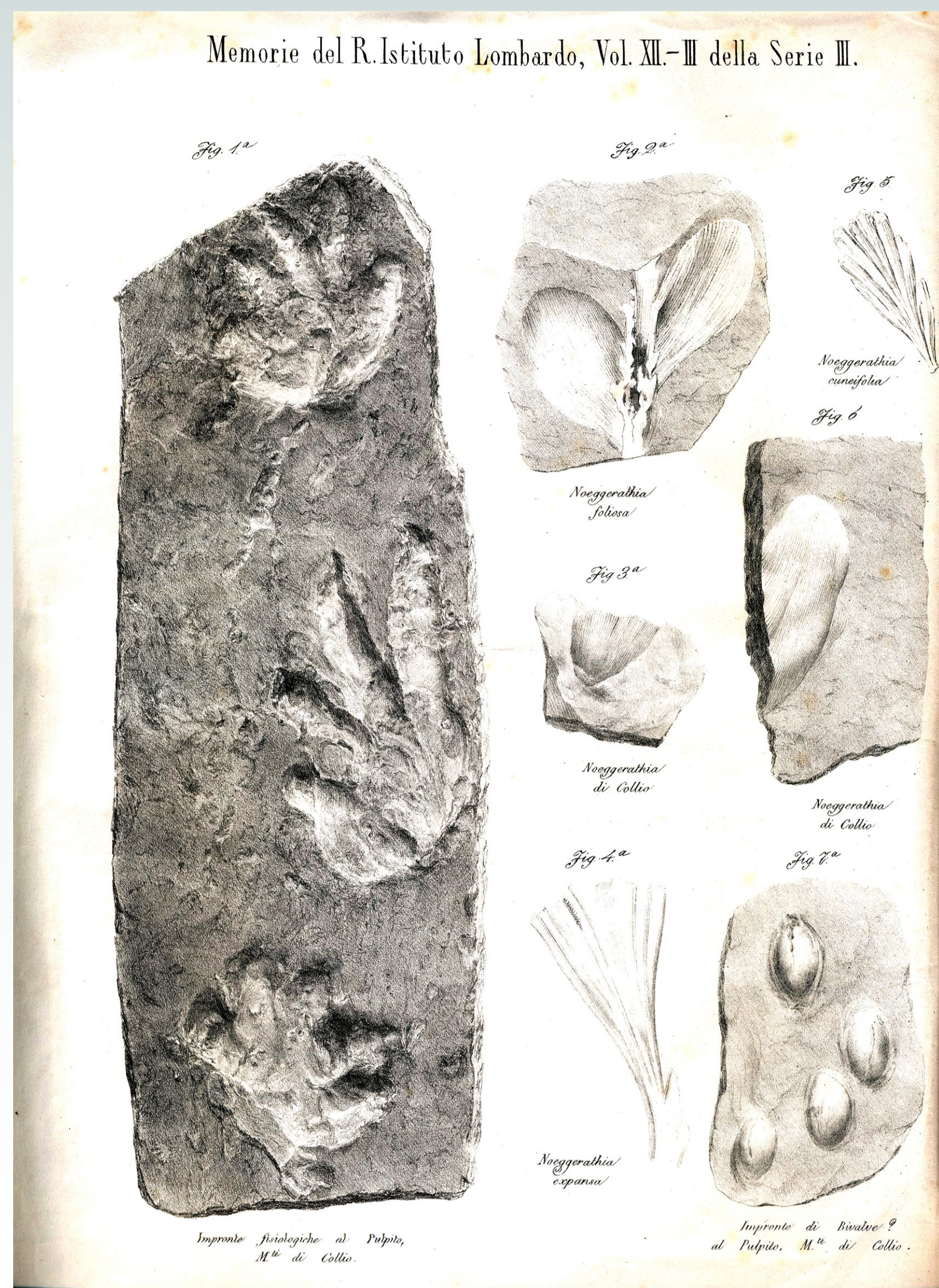


Fig. 1. The original figures of Curioni (1870), showing a lithograph of the specimen (figs. 1a-7a).

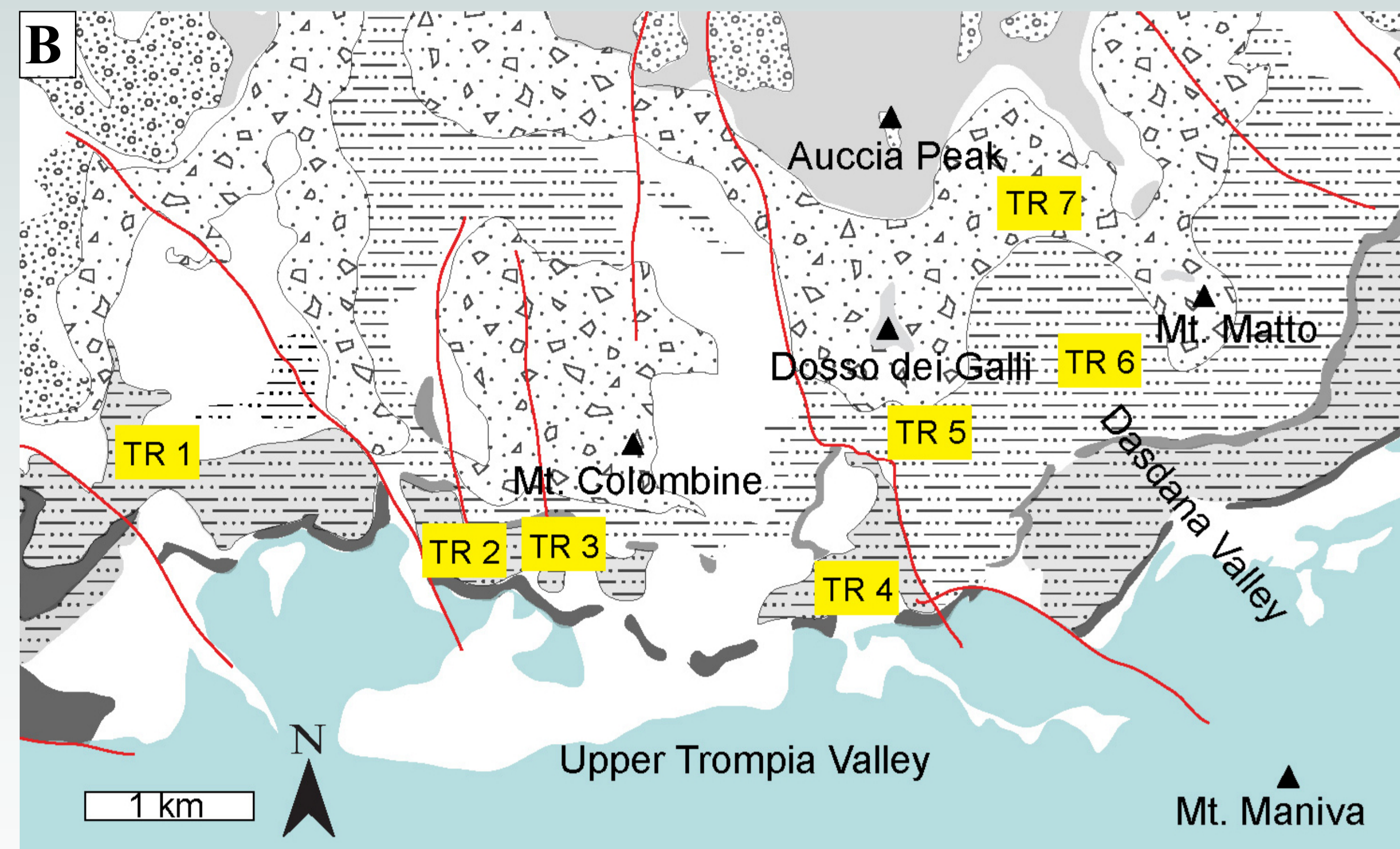
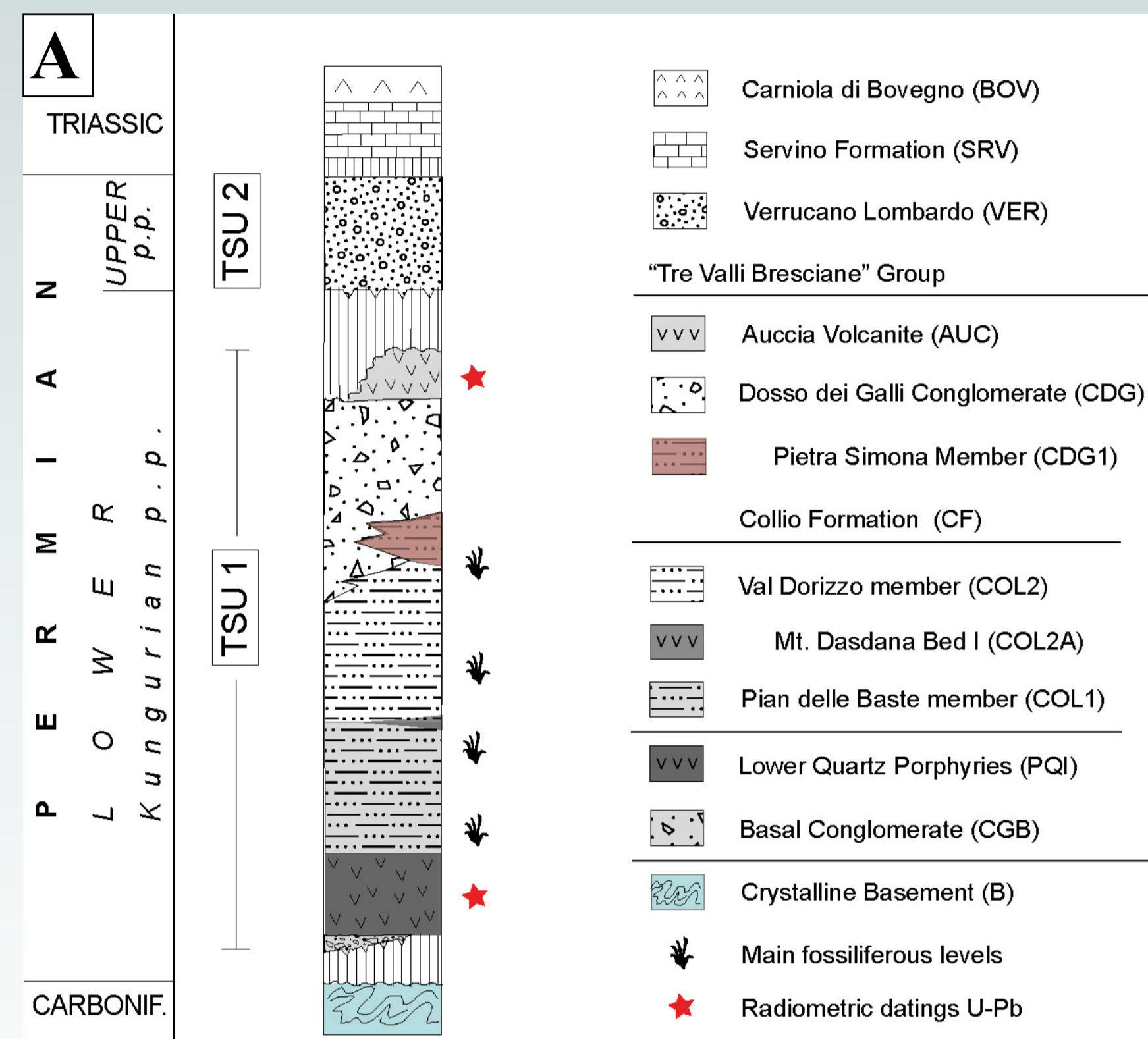


Fig. 2. Location and geological setting. A) Synthetic chrono- and litho-stratigraphic scheme of the Collio Basin. B) Simplified geologic map of the area of discovery. TR 1-7 are the trace fossil localities in upper Trompia Valley, the "Pulpito" locality is TR 3.

Material and Methods

The original specimen belongs to the prestigious Curioni Collection (donated by Curioni to the "Regio Ufficio Geologico" in the year 1877) and is nowadays preserved in the Paleontological Collections of ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) in Rome (Inventory number 4426; <http://www.isprambiente.gov.it/it/museo/collezioni/collezioni-paleontologiche/paleo-reperti/impronta-di-orme-di-rettile>). It is a small slab of about 30x15x1 cm of greenish laminated mudstone, coming from the locality "Pulpito", in the topmost part of the Pian delle Baste member of the Collio Formation (Fig. 2) (Cassinis et al. 2012). This unit is constituted

by intensely-laminated dark grey to green mudstones containing abundant tetrapod and invertebrate traces and plant remains (Avanzini et al. 2011; Marchetti et al. 2015), and is interpreted as a marginal lacustrine environment. The Collio Formation is dated by radiometric methods as lower Kungurian (late Cisuralian, Permian) (Schlatteger & Brack 2007). The slab was newly analysed strictly considering the footprint taphonomy (i.e. extramorphologies) and interpreting the combined results of classic ichnologic studies and measurements with more recent ones (i.e. digital photogrammetry).

Tetrapod ichnology

The specimen N. 4426 shows three medium-sized plantigrade footprints and several small-sized digitigrade footprints all preserved as concave epirelief. The pes-manus couple and the single imprint are attributed to the ichnogenus *Amphisauropus* Haubold, 1970. The diagnostic features include the pentadactyl and plantigrade manual tracks, wider than long with short and thick digits; rounded digit terminations; digits increasing in length from I to IV; digits III and IV of similar length; footprint functionality clearly medial (Fig. 3C). The pes is sensibly

larger than the manus and shows a broad sole with a well-impressed basal pad of digit I (Fig. 3) and relatively long and straight digits sensibly increasing in length from I to IV, with rounded and deeply impressed digit terminations (Fig. 3C). Expulsion rims were observed as well, especially posteriorly to the proximal part of the single manual imprint (Fig. 3C). These tracks were probably produced by a seymouriamorph reptiliomorph. Other footprints on the same surface were instead assigned to *Dromopus* Marsh, 1894 (Fig. 3A-B). They are charac-

terized by a digit IV sensibly longer than digit III in both pes and manus, same morphology of pes and manus, and digits showing distinct pads and claw impressions. These tracks were probably left by diapsid reptiles or bolosaurid parareptiles. The first footprint to be impressed was probably the single *Amphisauropus* track (it is deeper and shows more developed expulsion rims), then the *Amphisauropus* pes-manus couple and finally the digitigrade *Dromopus* tracks, lightly impressed and superimposed to the *Amphisauropus* footprints (Fig. 3B).

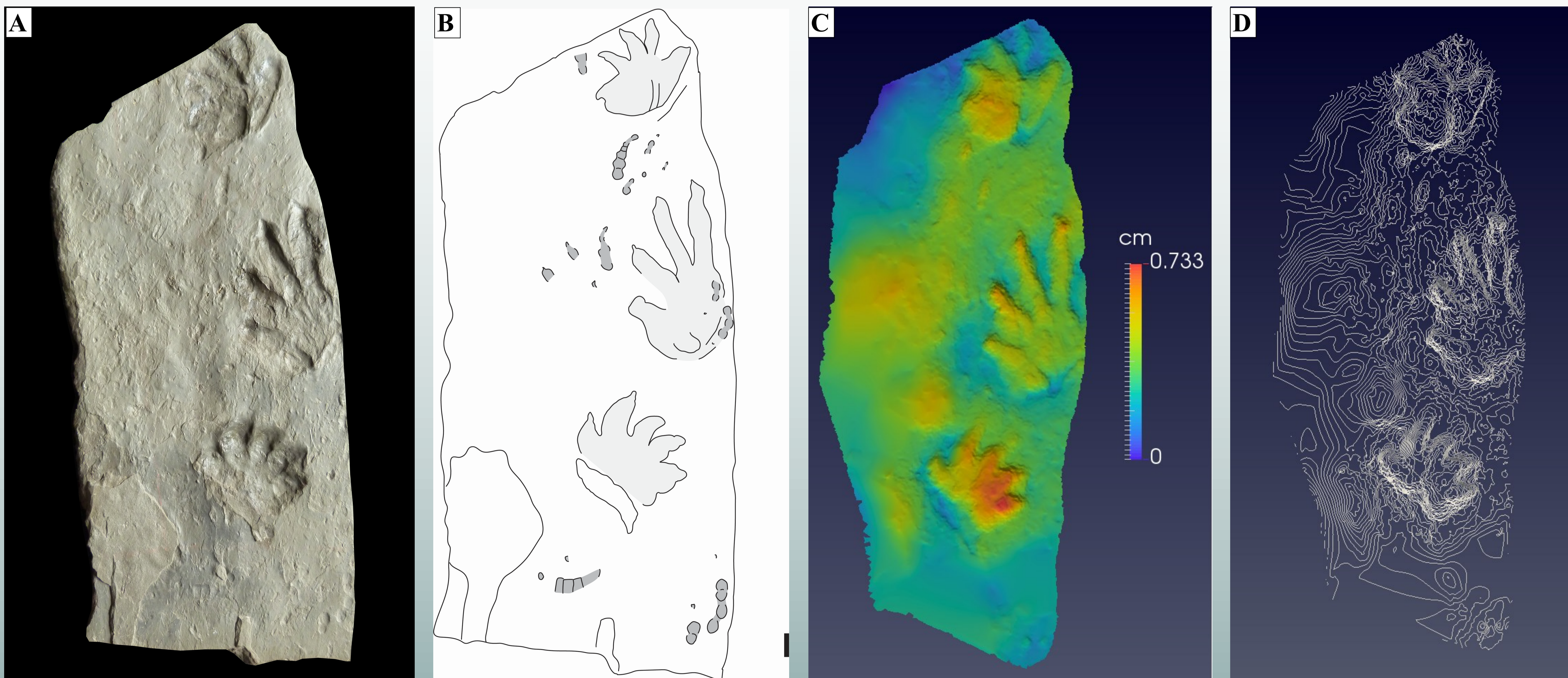


Fig. 3. Specimen N. 4426. A) Photograph in controlled light conditions. B) Interpretive drawing. *Amphisauropus* in light grey, *Dromopus* in grey, scale bar 1 cm. C) Colour depth map of the photogrammetric 3D model. Note the medial functionality of *Amphisauropus* manual tracks, the deeply impressed basal pad of digit I and digit tips of *Amphisauropus* pes and the expulsion rims. D) Contour map of the 3D model, with lines at every 5 mm. Note the steep footprint margins.

Conclusions

The description by Curioni (1870) represents, in all respects, the first description of vertebrate footprints from Italy, the first worldwide on material attributable to *Amphisauropus* (before Geinitz & Deichmüller 1882), and one of the earliest on material referable to *Dromopus*. The studied slab could also represent the earliest finding of *Amphisauropus*, but presently we only know a very approximate time range for Don Bruni's discovery (between 1856, starting date of the field work and 1868, date of first reference to this material). The new description of Curioni's slab constitutes a very significant contribution to the history of vertebrate ichnology in Italy and in the world. The case study highlights once again the importance of communication between the institutions that preserve fossil material and of proper repositories for the preservation of geo-paleontologic heritage, allowing further and advanced analyses of original specimens even after almost 150 years from the last study.

References

Avanzini M., Contardi P., Ronchi A. & Santi G., 2011. Ichnosystematics of the Lower Permian invertebrate traces from the Collio and Mt. Luco Basins (North Italy). *Ichnos*, 18, 95–113; Cassinis G., Perotti C. R., & Ronchi A. 2012. Permian continental basins in the Southern Alps (Italy) and peri-mediterranean correlations. *Int. J. Earth Sci.*, 101, 129–157; Curioni G. 1870. Osservazioni geologiche sulla Val Trompia. *Rend. Ist. Lomb. Sci. Lett. Arti Mem.*, 3, 1–60; Geinitz H. B. 1869. Über fossile Pflanzenreste aus dem Dyas von Val Trompia. *N. Jb. Miner. Geol. Paläont.*, 456-461; Geinitz H.B. & Deichmüller J.V. 1882. Die Saurier der unteren Dyas von Sachsen. *Palaeontographica*, 29, 1–4; Haubold H. 1970. Versuch der Revision der Amphibien-Fährten des Karbon und Perm. *Freib. Forsch. C* 260, 83–117; Marchetti L., Ronchi A., Santi G., Schirolli P. & Conti M. A. 2015. Revision of a classic site for Permian tetrapod ichnology (Collio Formation, Trompia and Caffaro valleys, N. Italy), new evidences for the radiation of captorhinomorph footprints. *Palaeog., Palaeoec., Palaeoec.* 433, 140-155. Marsh O. C., 1894. Footprints of vertebrates in the coal measures of Kansas. *Am. J. Sci.*, 283, 81–87; Schlatteger U. & Brack P. 2007. Crustal-scale magmatic systems during intracontinental strike-slip tectonics: U, Pb and Hf isotopic constraints from Permian magmatic rocks of the Southern Alps. *Int. J. Earth Sci.*, 96, 1131–1151.